TRABAJO DE FIN DE GRADO

Virtual Reality and foreign language learning: Analysis of the 6 most popular mobile apps from *Google Play Store* and *App Store* to learn English

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1. ABSTRACT

Research in the area of mobile assisted language learning (MALL) has shown that smartphones offer multiple opportunities for supporting foreign language learning. The development and increasing accessibility of new tools such as virtual reality technology (VR) has opened new perspectives in the area of MALL, paving the way for a new research field called virtual reality assisted language learning (VRALL). In this context, the current study aims to explore the potential of VRALL by analyzing the 6 most popular VR apps from *Google Play Store* and *App Store* to learn English, with a special focus on language contents and the learning approaches provided. Results suggest that although VR technology provides new opportunities for language learning, VRALL is still on the fringes and more research needs to be done in order to take advantage of the real potential of VR.

Keywords: *virtual reality*, *virtual learning environments*, *language learning*, *commercial apps.*

1.1. Resumen y palabras claves

La investigación en el área del aprendizaje de lenguas asistido por dispositivos móviles (MALL) muestra que los teléfonos móviles ofrecen una gran variedad de posibilidades para ayudar a aprender una lengua extranjera. El desarrollo y el fácil acceso a nuevas herramientas como la tecnología de realidad virtual (RV) han abierto nuevos horizontes en el área de MALL, preparando el terreno para un nuevo campo de investigación llamado aprendizaje de lenguas asistido por realidad virtual (VRALL). De este modo, este estudio busca explorar el potencial del VRALL mediante el análisis de las 6 apps de RV más populares en *Google Play Store* y *App Store* para aprender inglés, centrándonos en los contenidos lingüísticos y en los enfoques de aprendizaje que proporcionan estas apps. Los resultados indican que, aunque la RV aporta nuevas oportunidades para el aprendizaje de lenguas, el VRALL todavía permanece al margen, y se necesita más investigación sobre el tema para poder aprovechar el verdadero potencial de la RV.

Palabras clave: *realidad virtual*, *entornos virtuales de aprendizaje*, *enseñanza de lenguas*, *apps comerciales*.

2. INTRODUCTION

My interest in the use of Virtual Reality (VR) for foreign language learning was motivated due to my personal experience as a foreign language student as well as collaboration with different lecturers from the University of Cádiz, who introduced me to this research field. Another aspect which influenced my choice of the research topic was the fact that as an English language learner and future language teacher I am interested in becoming familiar with the most recent trends in foreign language teaching with a special focus on the use of novel technologies such as virtual learning environments and mobile technologies. According to Chapelle and Sauro (2017:1), the use of computer technology for all aspects of foreign language learning has dramatically increased in the last decades due to the enormous spread of the internet and access by a great part of the population. Additionally, the technological development has allowed the implementation in the classroom of innovative technologies and learning approaches such as adaptive learning, augmented reality, personal learning environments or learning online via social networks, amongst others.

The objective of the current study is to analyze the educational potential of some of the most recent technologies which are Virtual Reality (VR) combined with the use mobile technologies such as smartphones. Both provide in our opinion interesting opportunities for implementing new learning environments and hence for supporting students and teachers in the foreign language learning process. According to Linowes (2015:2), VR refers to a computer-generated simulation of a 3D environment, that seems very real to its users due to its immersive nature. By using special electronic equipment such as VR headsets, the users get a strong feeling of being immersed in the virtual environment.

VR is not a completely new technology. Instead, it has been existing for many years, but until recently its access was limited mainly to "academic research labs and high-end industrial and military facilities" (Linowes, 2015:3). However, with the technological development in the last decade, the access to VR experiences has been made available to a consumer-level, preparing the path for the development of a wide range of apps in very different areas of teaching and research (Andersen et al., 2019:1; Berns et al., 2018:776; Wang et al., 2018:626). Moreover, by combining mobile learning (m-learning), which is "learning by means of personal electronic devices" (Crompton, 2013:4) with VR technology, the opportunities of

creating immersive learning environments, that are accessible anytime and anywhere, have been increased.

In this context, the main goal of the current research is to analyze the 6 most downloaded VR-based mobile apps from platforms such as *Google Play Store* and *App Store* and to identify eventual trends learning languages through VR. The focus of the analysis will be on the identification of learning contents (vocabulary, grammar, etc.), language competences (listening, speaking, reading, writing) and the learning approaches (individual learning versus collaborative learning, form-focused versus task-based learning) which are generally used.

The organization of this Senior Thesis will be the following: Section 3.1 provides a brief introduction to the historical background and development of VR, from Virtual Worlds (VWs) to Augmented Reality (AR), followed by Section 3.2, which offers an insight into the current concept of VR, describing its technical characteristics as well as the different types of implementation that can be found in the literature. Next, in Section 3.2.2. different examples from the use of VR in education will be analyzed, followed by Section 3.3., which will describe a number of examples from the area of foreign language learning. So, in that Section, we will focus on VRALL, by comparing and analyzing first (in Sections 3.3.1. and 3.3.2.) the main differences between MALL and VRALL. Finally, Section 4 presents the different hypotheses the current study is based on, followed by Section 5 and 6, that aims to provide evidences in favor or against the established hypotheses by analyzing the 6 most downloaded language apps. The results of the analysis will be presented in Section 7 and 8.

3. STATE OF THE ART

3.1. Background of Virtual Worlds and Augmented Reality

A review of the literature shows that in the last decades there has been a growing trend to implement a set of emerging technologies such as AR and VR technologies, together with VW-based environments to support teaching-learning processes (Lin & Lan, 2015:492; Lin, Lan & Kan, 2013:76). VR started in 2003 with the use of VWs. A VW is a multiuser computer-based simulated environment that allows its users to create their own personal avatars by which they can interact with the environment as well as other VW users via their avatars (Aichner & Jacob, 2015:260; Bartle, 2003:613). According to Sadler (2017:185), some of the main

affordances of VWs are the fact that they are 3D online environments, allowing real-time interaction as well as 24-hour accessibility.

With regard to AR, its growth is directly related to the development of smartphones. In 2005, with the development of smartphones, the analysis of physical environments in real time became possible. This means the camera system of the smartphones was able to integrate reality with virtual objects (Jongedijk, 2009). According to Schueffel (2017:2), AR allows to create an enhanced version of the physical real-world reality. This enhanced version is created by superimposing elements such as sounds, images or videos that has either been generated by the computer or extracted from the real-world. The purpose of the AR technology was to change the perception of the reality by adding digital elements to images extracted from the real-world (Kato, 2010).

3.1.1. VWs and AR in the area of Foreign Language Learning

In terms of VWs, *Second Life* (*Figure 1*) has been one of the most popular virtual learning environments (VLEs) for foreign language learning and between 2009 and 2013, it has even been the most used VW (Aydin, 2013:59; Lin & Lan, 2015:490).

Figure 1. Screenshot from *Second Life* displaying a VW simulating London.

On the other side, there are other environments such as AR, that has also been implemented for foreign language learning. An example of such implementation can be found in the *Mondly* app, which integrates an AR mode, where the app combines real-world images with virtual elements (*Figure 2*).

Figure 2. Screenshot from the *Mondly* app displaying the AR mode.

Several studies which have investigated both VWs and AR technology outline the potential of both tools for enhancing learners' motivation while at the same time fostering learning contents (Akçayır & Akçayır, 2017:8; Aydin, 2013:59; Lin, Lan & Kan, 2015:495).

3.2. Virtual Reality

Nowadays, VR involves wearing a VR headset to view stereoscopic 3D scenes. VR apps allow users to look around by moving their heads and walking around by using hand controls or motion sensors. The VR environment allows the user to fully engage in a highly immersive experience (Berns et al., 2018:777; Linowes, 2015:3).

Concerning the background of the current concept of VR, it was in 2015 when the *Oculus VR* company launched the first commercial version of their VR headset: *Oculus Rift*.

Thanks to the integration of a display in the VR headset *Oculus Rift* (*Figure 3*) allowed its users to feel immersed in a 3D environment (Sadler, 2017:185) One year later, in 2016, the *Sony* company launched *PlayStation VR*, while other companies such as *HTC* and *Valve Corporation* launched *HTC Vive*. The investment the different companies made in VR led to an increasing use and interest in VR technologies. Nonetheless, since VR technology was still expensive the access to this technology was limited.

Figure 3. *Oculus Rift*: VR headset launched by the *Oculus VR* company.

The problem of high prices was solved when the *Google* company launched *Google Cardboard*, a VR viewer which was totally made of cardboard (*Figure 4*) and available for 15 €. The main difference between *Oculus Rift* or *HTC Vive* VR headsets and *Google Cardboard* is that while the first VR headsets integrate a display and must be connected to a computer, *Google Cardboard* works as a casing for smartphones. This allows that the virtual environment is displayed on the smartphone's screen. In 2016, more than 5 million people had tested *Google Cardboard* viewer and more than 10 million of immersive apps were available on *Google Play Store* (Bavor, 2016). Since then, several economic versions of VR headsets have been launched, which allowed more people to access VR technology.

Figure 4. *Google Cardboard*: VR viewer launched by *Google*.

With regard to VR three types of virtual environments can be distinguished (Sherman & Craig, 2003:365). These are the followings:

- **Non-immersive virtual environments** which are immersive implementations of VR technology with the lowest level of immersion that can be accessed by using high resolution monitors.
- **Semi-immersive virtual environments** that allow its users to partially immerse in the virtual environment (e.g. flight simulators).
- **Immersive virtual environments** where users feel a realistic experience, since they are immersed in a 3D virtual environment. With the use of Head-Mounted Displays (HMDs), the user has a great field of vision (e.g. VR apps).

Considering that the aforementioned classification is from 2003, and that VR technology has developed since then, the classification could be reduced to two types: immersive environments and non-immersive environments. Immersive environments would be those where the users are immersed in the environment by means of using VR headsets. Non-immersive environments would correspond to those which use high resolution monitors in order to access to the virtual environment (Hagström & Winman, 2018:3).

3.2.1. Classification of Virtual Reality apps

With regard to VR apps, various authors (Berns et al., 2018:776; Izard et al., 2017:2) distinguish between two types of apps:

- **Apps that are based on spherical recordings or panoramic images.** These apps are made of real-world images such as 360º videos or panoramic images. The videos or images can be mixed up either with bots or real people (*Figure 5*).

Figure 5. Screenshot from the *Let's date!* app (Berns et al., 2018).

- **Apps built on a virtual environment.** These apps are completely computer generated, which produces a lower level of realism (*Figure 6*). In this case, the immersion is less realistic compared to apps based on spherical recordings or panoramic images (Berns et al., 2018:776).

Figure 6. Screenshot from the *VR Word Chase* app.

3.2.2. Virtual Reality in Education

Concerning the use of VR in education, this technology has been implemented for several purposes. VR allows creating highly interactive 3D environments. These environments could represent either real or fictitious situations. Following this, this technology can be exploited as a tool for education due to its unique technical features, which are the possibility of creating 3D spatial representations, the use of multisensory channels for user interaction or the immersion of the user in the virtual environment (Mikropoulos & Bellou, 2006:122).

The purpose of using VR technology is creating a feeling of immersion. In this sense, VR allows its users to immerse in a virtual environment and to directly interact with its content (Berns et al., 2018:776; Linowes, 2015:3). The potential of VR technology for education is based on its two main characteristics: immersion and the possibility of controlling the virtual environment (Hedberg & Alexander, 1994:240; Lee, Wong & Fung, 2010:87; Whitelock, Brna & Holland, 1996:138; Winn & Windschitl, 2000:6).

Concerning some of the possible disadvantages a continued use of VR technology may cause, these are mainly problems such as anxiety, dizziness or sickness (Maughan, 2016).

3.3. Virtual Reality Assisted Language Learning (VRALL)

Regarding the use of VR for foreign language learning, the literature distinguishes between two different concepts: Mobile Assisted Language Learning (MALL) and Virtual Reality Assisted Language Learning (VRALL). Although VRALL includes both, computer and mobile learning, the focus of the current study will be only on mobile learning. It is important to stress the need for exploring the potential and added value of VR, this is, taking advantage of the sense of immersion and the possibility of creating Virtual Learning Environments. In order to implement VR for learning, apps designers need to understand the challenges of using VR technology for instruction rather than counting on the novelty of the approach (Huang et al., 2010:1180).

3.3.1. Mobile Assisted Language Learning (MALL)

MALL implies the use of technologies such as smartphones for foreign language learning. It differs from Computer Assisted Language Learning (CALL) in the portability of the devices used, enabling new ways of learning (Kukulska-Hulme & Shield, 2008:4). Hence, the key feature of MALL is the device portability, which offers several advantages for language learning (e.g. easy access to resources) (Kukulska-Hulme and Traxler, 2013:245). However, as outlined by Stockwell and Hubbard (2013:3) there are also various disadvantages that need to be taken into account. Those are mainly physical issues, related to the screen size of the devices,

the processor speed as well as the battery life as well as pedagogical issues that refer to the learning approaches most of the current applications are based on. In this context, Stockwell and Hubbard (2013:11) stress the need for exploring the potential and added value of mobile devices to provide novel learning approaches rather than implementing traditional learning approaches.

3.3.2. VRALL

VRALL means learning languages with the aid of VR technology. The concept first appeared in December 2018 together with the development and implementation of VR in the area of foreign language learning. The interest in exploring VR technologies for foreign language learning is based on the assumption that language immersion is the most effective way of learning a foreign language (Kaplan-Rakowski & Wojdynski, 2018:1). VR allows learners to experience a sense of immersion through 360º recordings.

In terms of learning contents VRALL seems to follow the path of MALL, where vocabulary was one of the main contents which were worked on. In the case of the use of VR for foreign language learning, vocabulary is expected to be the main content in all the apps analyzed.

3.3.3. Learning approaches in VRALL

3.3.3.1. Individual learning versus collaborative learning

In individual learning, learners work and complete a task on their own. On the other side, in collaborative learning, learners are expected to work or interact with other learners in order to complete a task. With the use of mobile devices, which allows collaborative working, it is expected that language apps exploit this feature. However, there are evidences that show that most of the currently available language apps continue focusing on individual learning rather than collaborative learning (Berns & Palomo-Duarte, 2015:51; Berns et al., 2017:121; Kukulska-Hulme & Viberg, 2018:208). Covering the topic of the current study VRALL seems to follow the path of MALL. For that reason, it is expected that, probably, most of the currently

available VR-based apps will focus on an individual learning approach rather than on a collaborative one.

3.3.3.2. Form-focused learning

In form-focused learning, learners' primary focus is on form. In fact, this learning approach consists in any activity designed to induce language learners to pay attention to linguistic form (Ellis, 2001:2), with a special focus on lexical and grammar items. In order to process the information received and to integrate it into the own learning process, the learner must be aware of the "forms and the meanings these forms realize in the input" (Laufer, 2005:224).

There are evidences that, through this learning approach, learners have been able to acquire explicit knowledge of complex grammatical rules (Ellis, 2006:87). According to Ellis (2006:93), explicit representation of linguistic forms is needed at the beginning of the learning process in order to allow learners to construct a basis of knowledge that learners could use. Then, by means of implicit learning, these linguistic forms are developed.

3.3.3.3. Task-based learning

Task-based learning consists in a pedagogical task, having a primary focus on meaning, in which language learners are required to use the target language to accomplish a real-world activity, for instance, making a reservation or buying something in a shop (Nunan, 2014:4).

The pedagogical task should fulfill four aspects. As stated before, the focus must be on meaning. The task must have a "gap", this is, an information gap, a reasoning gap, or an opinion gap (Prabhu, 1987:60). Also, learners are responsible for selecting the appropriate resources (linguistic and non-linguistic) to complete the task. The outcome of the task is not linguistic. That is to say that language is used to achieve the outcome (Ellis, 2009:238).

4. PURPOSE AND HYPOTHESES

The aim of the current study is to identify the trends that can be observed in VRALL by means of analyzing the 6 most popular VR mobile apps from *Google Play Store* and *App Store* to learn English. The analysis is based on three hypotheses (H):

H_1: VR provides new opportunities for learning vocabulary and strengthening oral skills.

H_2: The use of VR technology allows to create highly immersive environments that are often difficult or, even, impossible to implement in conventional learning environments.

H_3: The majority of commercial apps based on VR, provide individual and form-focused learning approaches rather than collaborative and communicative-based approaches.

In order to find evidences in favor or against the established hypotheses, four research questions (RQs) were specifically addressed by this study:

$RQ_{1.1}$: How do VR-based apps teach vocabulary? What kind of learning activities do they provide?

$RQ_{1.2}$: How do VR-based apps work on oral skills? What kind of learning activities do they provide?

$RQ_{2.1}$: What kind of environments do VR-based apps provide? Are these environments different from those implemented in conventional teaching environments?

$RQ_{3.1}$: Which kind of learning approaches do VR-based apps provide?

5. METHODOLOGY

With a view to find evidences in favor or against the established hypotheses, we have used a corpus of 6 language apps based on VR. The list of the selected apps for the analysis was obtained from a search carried out on two of the most popular commercial platforms:

Google Play Store (for *Android*) and *App Store* (for *iOS*). The search was done on April 2, 2019 and the key terms that were used to identify the apps were: "VR language".

The search resulted in a total number of 29 apps, from which 17 were excluded since they were not related to foreign language learning.

With regard to the results obtained from *Google Play Store*, 12 out of 20 apps were excluded. The exclusion criteria followed were first, that an app was a VR video player which allows to watch 360º video; second, that an app was not related to VR technology; and third, that an app was simply not related to language learning. Regarding the results obtained from our search on *App Store*, it is noteworthy that there were only 9 apps that could be identified, from which once again 5 apps had to be excluded. In this case, the exclusion criteria were based either on the fact that the app was not related to VR technology and/or language learning, or that the platform did not provide any access to the app.

Although the remaining 12 apps belong to the category of education not all apps focus on language learning which explains why once again 2 of the apps had to be excluded from the current analysis. Finally, the remaining apps were organized in a dataset and filtered out based on the number of downloads registered by the respective platforms. The final result was that 10 apps were related to language learning from which only the 6 most downloaded apps were selected for the current analysis. These were: *Virtual Speech-VR Courses*, *Beyond VR-Public Speaking VR Cardboard App*, *PanoLingo, Mondly VR: Learn Languages in VR*, *VR Learn English* and *Virtual Reality Speaking Simulator*.

As illustrated by *Figure 7*, the most downloaded app is *VirtualSpeech-VR Courses* with more than 50,000 downloads. It is followed by *Beyond VR-Public Speaking VR Cardboard* App, with 10,000+ downloads; *Panolingo*, with 5,000+ downloads; *Mondly VR: Learn Languages in VR* and *VR Learn English*, with 1,000+ downloads each one; and, finally, *Virtual Reality Speaking Simulator*, with 100+ downloads. The majority of the apps are free, with the exception of *Mondly VR*, which is priced at 4.99 €. Although *VirtualSpeech-VR Courses* is available for free, it offers in-app purchases, such as training courses for delivering different kinds of presentations, preparing for a job interview or training business skills.

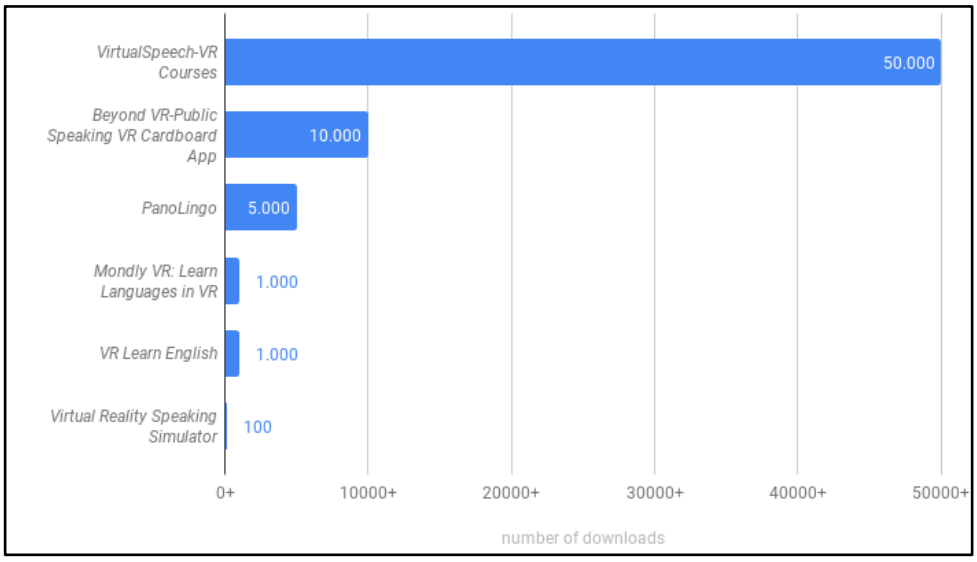

Figure 7. Apps filtered out by the number of downloads.

In the following, all 6 apps will be analyzed focusing on different aspects related to language learning. The aspects that will be analyzed will focus on language contents (vocabulary and grammar), language competences (listening, speaking, reading and writing) as well as aspects such as individual learning versus collaborative learning and form-focused learning versus task-based learning.

6. ANALYSIS

VirtualSpeech-VR Courses, the most downloaded app, provides several scenarios where the learner can practice his/her oral presentations. Those scenarios are a conference room, a meeting room or a classroom (*Figure 8*).

Figure 8. Screenshot from the main screen and menu of the *VirtualSpeech-VR Courses* app.

As the *VirtualSpeech-VR Courses* app was not specifically designed for foreign language learning, the app does not provide any exercise for learning vocabulary or grammar. However, as illustrated by *Table 1*, the app offers for language learners very valuable materials to strengthen their language competences with a special focus on speaking and listening as well as reading.

Language contents		Vocabulary	Grammar	
		✗	✗	
Language competences	Listening	Speaking	Reading	Writing
	✓	✓	✓	✗

Table 1. Language contents and competences that are practiced with the *VirtualSpeech-VR Courses* app.

Speaking and listening can be practiced either through a course offered by the app, called "impromptu speech"[1], or by simply giving a talk to an audience in any of the different scenarios provided by the app.

For the strengthening of speaking, the app integrates a speech analysis function, which provides the learner with valuable feedback at the end of his/her talk. Feedback is based on three aspects: the speech rate, the volume of the voice as well as eye contact established with the audience (*Figure 9*). The app also offers the opportunity of practicing reading based on the example of a famous speech, which is displayed on the learner's screen, so that s/he can read it to the audience.

[1] The app delivers a total number of 15 pictures, allowing its users to describe each of the pictures for 30 seconds until the next picture is displayed.

Figure 9. Screenshot from the *VirtualSpeech-VR Courses* app displaying the feedback provided by the app.

Furthermore, the *VirtualSpeech-VR Courses* app integrates a live feedback function, based on the same aspects as the speech analysis function: the speech rate, the volume of the voice as well as eye contact (*Figure 10*).

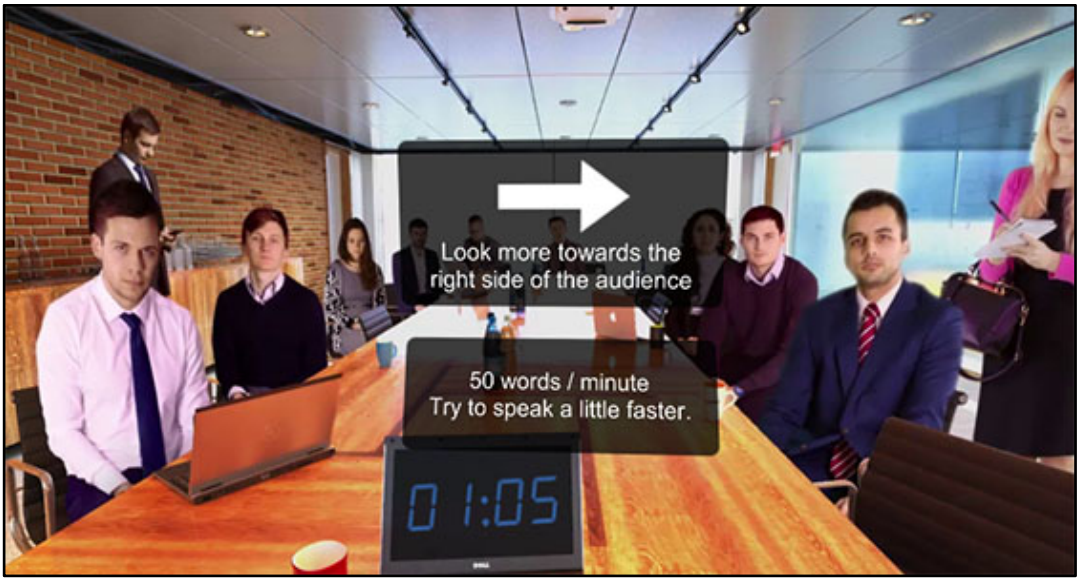

Figure 10. Screenshot from the *VirtualSpeech-VR Courses* app displaying the live feedback function.

Furthermore, the app offers its users the opportunity to experience a job interview, where s/he has to choose first, a job sector (*Figure 11*) such as *Google* or *Apple* (standing for the technology sector) and then, answer several questions related to the job sector chosen (e.g. “How would you describe yourself?”, “Why are you looking for a new job?”, “Could you think of three weaknesses that characterize you?”, etc.).

Figure 11. Screenshot from the *VirtualSpeech-VR Courses* app displaying the different job sectors that are offered by the app.

The learning approach that the *VirtualSpeech-VR Courses* app provides is an individual learning approach, offering the learner the opportunity to practice through real-world like experiences skills such as giving a speech to an audience or performing in a job interview.

Concerning the second most downloaded app, which is the *Beyond VR-Public Speaking VR* app, once again the focus of the app is not on foreign language learning and thus does not offer exercises to practice vocabulary or grammar. As seen before in the case of the *VirtualSpeech-VR Courses* app, the *Beyond VR-Public Speaking VR* app focuses on strengthening oral presentation skills. To this end, the app provides various scenarios (e.g. an auditorium, a boardroom or a classroom) where the learner can practice his/her oral presentation skills (*Figure 12*).

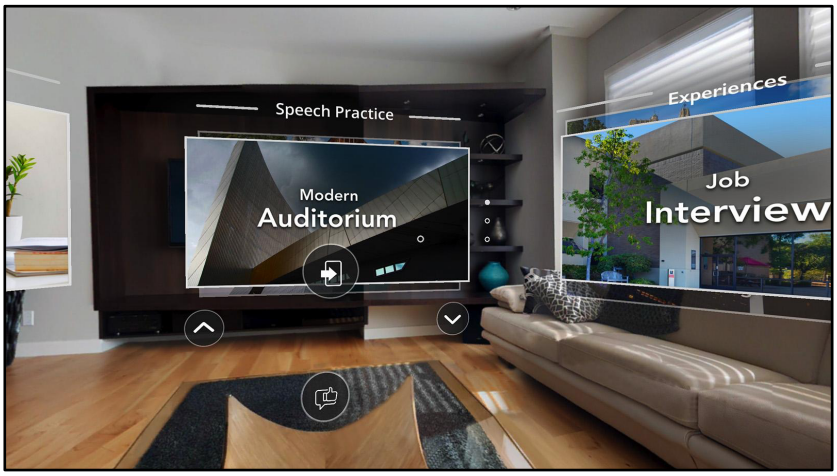

Figure 12. Screenshot from the main screen of the *Beyond VR-Public Speaking* app.

Although the *Beyond VR-Public Speaking* app was not specifically designed for foreign language learners, the app offers very valuable opportunities for strengthening some of the key-competences of foreign language learning, which are speaking, listening and reading (*Table 2*).

Language contents		Vocabulary	Grammar	
		✗	✗	
Language competences	Listening	Speaking	Reading	Writing
	✓	✓	✓	✗

Table 2. Language contents and competences that are practiced with the *Beyond VR-Public Speaking* app.

To this end, one of the options that the *Beyond VR-Public Speaking* app offers is providing the user with a random topic (e.g. "My favourite holiday is…", "Three things I do well are…", "Something I'm passionate about is…", etc.), which first appears on the user's screen and then invites him/her to give a short presentation on the given topic (*Figure 13*).

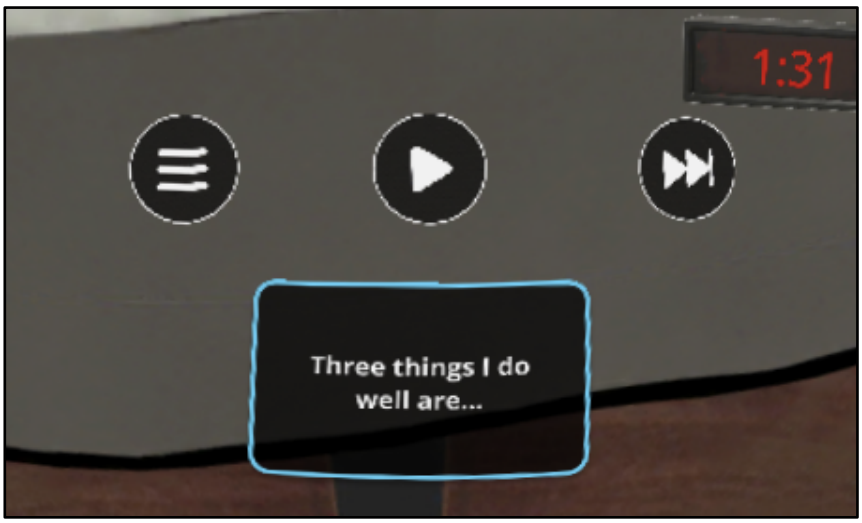

Figure 13. Screenshot from the *Beyond VR-Public Speaking* app displaying an example of a random topic, provided by the app.

The *Beyond VR-Public Speaking* app integrates a speech analysis function, which provides the learner with feedback at the end of his/her presentation. The feedback is based on three aspects: the volume of the voice, engagement and eye contact. These three aspects are automatically evaluated by the app. Additionally, the learner must give a self-evaluation of

his/her speech, based on three criteria: the content of his/her speech, how s/he felt while giving the speech and how s/he did perform (*Figure 14*).

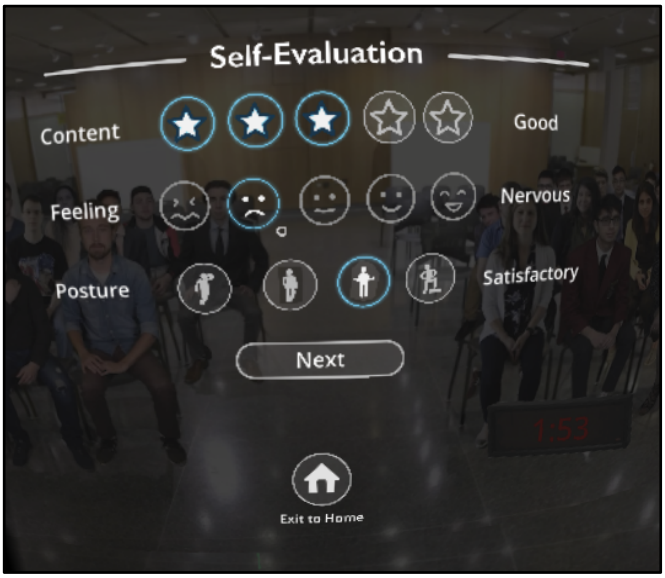

Figure 14. Screenshot from the *Beyond VR-Public Speaking* app displaying the self-evaluation screen.

Once the user has given his/her self-evaluation, the *Beyond VR-Public Speaking* app provides the user with feedback on his/her presentation, based on the volume of the voice, engagement and eye contact (*Figure 15*).

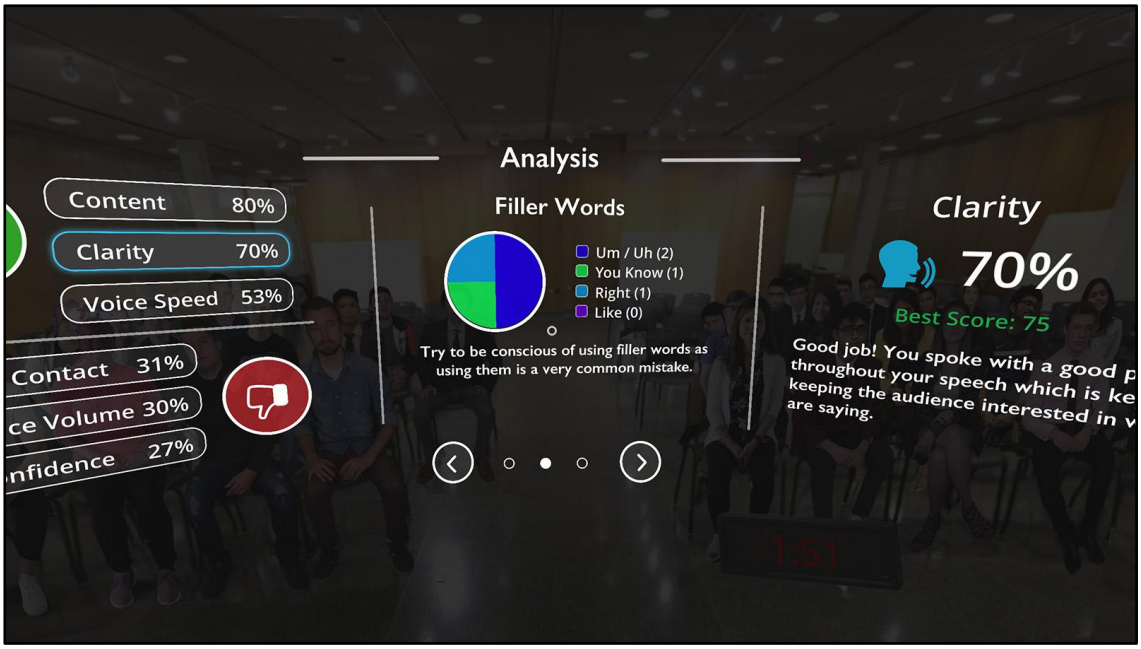

Figure 15. Screenshot from the *Beyond VR-Public Speaking* app illustrating the feedback provided by the app.

Additionally, the app provides the learner with the opportunity to feel immersed in a job interview. To this end, the user must -as previously seen in the case of the *VirtualSpeech-VR Courses* app- first select a job sector and then, answer various questions related to the job sector chosen (e.g. "What can you tell me about yourself?", "Why should I consider hiring you?", "Why do you wanna work here?", etc.). Some of the job sectors that are targeted by the app are finance, sales or human resources (*Figure 16*).

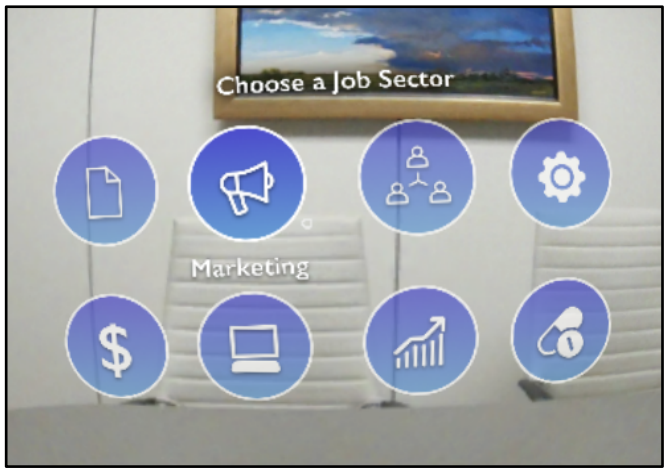

Figure 16. Screenshot from the *Beyond VR-Public Speaking* app displaying the job interview section.

At the end of each job interview, the app provides the learner with valuable feedback on his/her performance. The feedback consists in providing the learner with information on his/her particular strengths as well as offering some hints on how to improve his/her results (*Figure 17*).

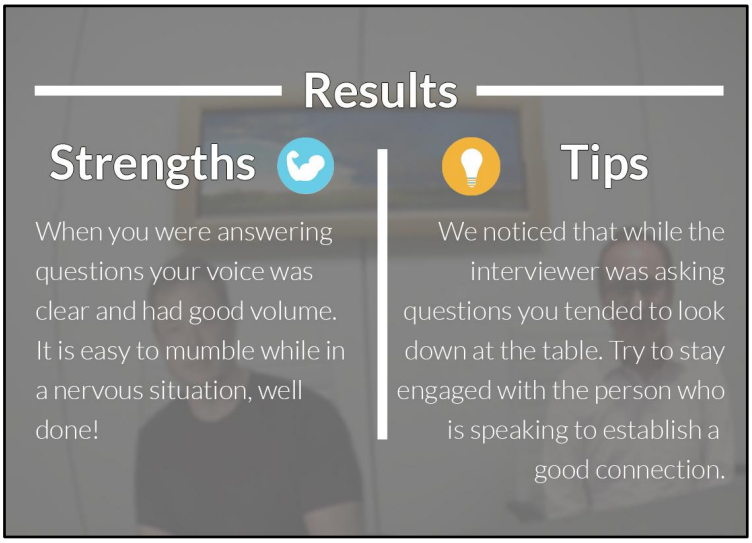

Figure 17. Example of the feedback provided by the *Beyond VR-Public Speaking* app after the interview.

With regard to the learning approach that is provided by the app, *Beyond VR-Public Speaking* focuses on individual learning. The app offers the opportunity of practicing real-world like experiences while receiving immediate feedback on his/her performance, while s/he is speaking to a virtual audience.

The third most downloaded app is *PanoLingo*. Unlike the previously analyzed apps, this app provides the learner with different immersive foreign language learning scenarios such as an appartement, office, shop, etc. (*Figure 18*).

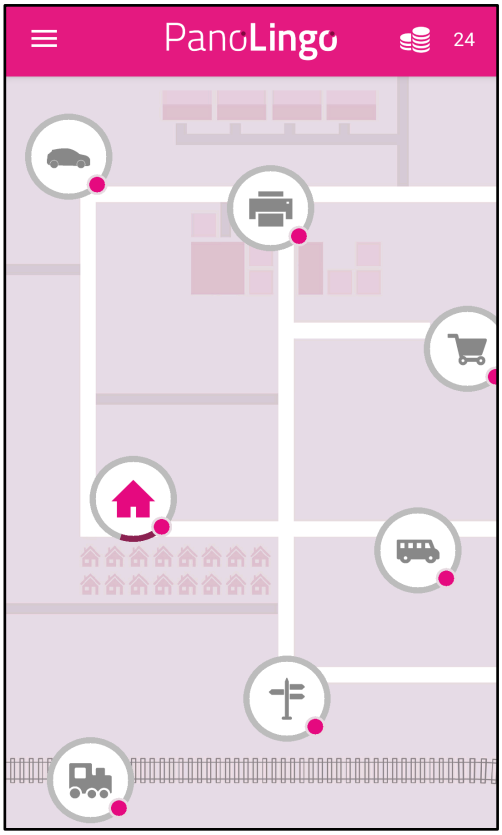

Figure 18. Screenshot from the menu of the *PanoLingo* app.

By giving the learner different instructions related to each of the learning scenarios, s/he is encouraged to interact with various objects that are placed in each scenario. In order to interact with the objects, the learner must use his/her VR headset by pointing at the different objects (*Figure 19*).

Figure 19. Screenshot from the *PanoLingo* app displaying the type of instruction that is provided by the app.

With regard to the language contents, that can be practiced with the app, these focus mainly on vocabulary and grammar. What differs *PanoLingo* from the previous apps and makes it a very valuable tool for foreign language learning is not only its learning approach but also the kind of learning scenarios that are provided. The latter aim to help students both, fostering their vocabulary knowledge as well as their grammar. Vocabulary is organized by different categories (e.g. home, office, etc.), so that the learner can choose the vocabulary s/he wants to work on by selecting the respective category. Moreover, the app provides the learner with the option to listen to the correct pronunciation of each vocabulary item (*Figure 20*). However, currently there are only two scenarios available (home and office), while the other scenarios appear as "coming soon".

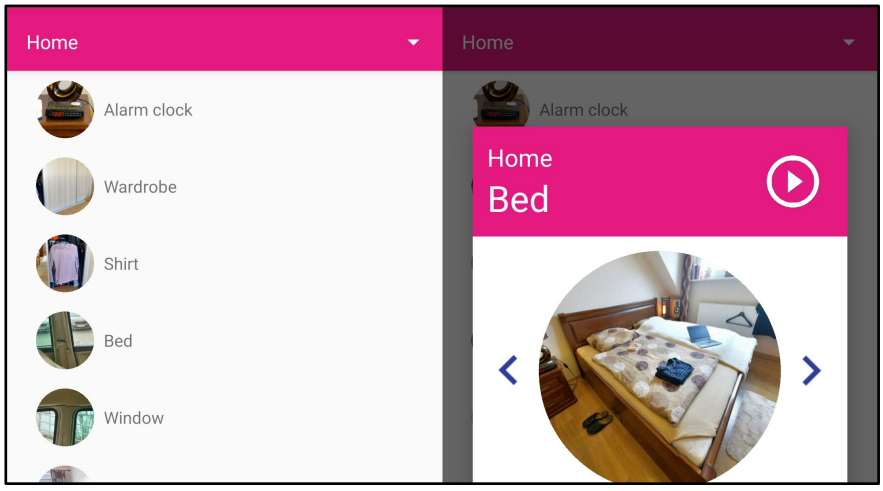

Figure 20. Examples from the vocabulary section of the *PanoLingo* app.

In terms of grammar, with the instructions given by the app, the learner can also practice some grammar items which are embedded in common phrases such as those used for giving orders (e.g. “Get the toothbrush!”, “Take a look at your image in the mirror!”, etc.) or those used for learning how to make a request (e.g. “You should do a little laundry, don’t you think?”, “You should clean your room.”, etc.).

The language competences that can be practiced with the *PanoLingo* app are listening and reading (*Table 3*).

Language contents		Vocabulary	Grammar	
		✓	✓	
Language competences	Listening	Speaking	Reading	Writing
	✓	✗	✓	✗

Table 3. Language contents and competences that are practiced with the *PanoLingo* app.

Both competences are practiced together by providing the learner with the correct pronunciation of each word and instruction as well as by projecting both of them on the learner’s screen. Once the instruction has been given by the *PanoLingo* app, the learner needs to search for the object s/he has to interact with. If the learner points at the correct object, the color of its mark changes into green, and the next instruction is delivered. On the contrary, if the learner points at the wrong object, the color of its mark changes into red, and the learner is asked to continue searching for the correct object (*Figure 21*).

Figure 21. Screenshot from the *PanoLingo* app displaying the feedback provided by the app.

With regard to the learning approach provided by the *PanoLingo* app, it is clearly based on individual and task-based learning. The app also integrates some features of gamification. These are based mainly on collecting points and bonuses, that allow the learner to pass to the next level.

Mondly VR: Learn Languages in VR, the fourth most downloaded app, is divided into two sections: a *vocabulary section* and a *conversation section*. The language contents that can be practiced with the app are vocabulary and grammar. In the *vocabulary section*, the learner can practice different vocabulary items related to topics such as the solar system, fruits, animals or vegetables. Once the learner has chosen a topic, the app automatically delivers different words related with the selected topic (e.g. lion, sheep, etc.). Each word appears written on the screen and is illustrated by means of a picture, while, at the same, the app provides the learner with the correct pronunciation of the word (*Figure 22*).

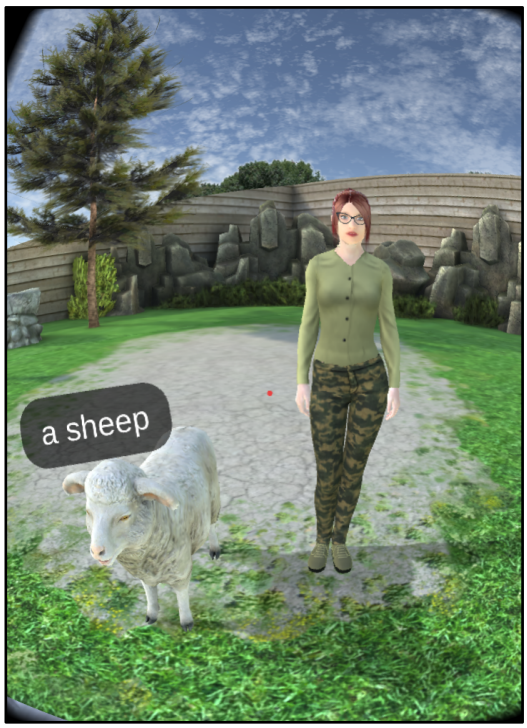

Figure 22. Screenshot from the *Mondly VR* app displaying an example from the animals category.

Following this, the learner is asked to practice the pronunciation of the respective word by pronouncing and recording it using the voice recorder, which is integrated in the app. Once the learner has pronounced the word correctly, a new word is delivered, and the learner is again

invited to pronounce the respective word. In case a learner fails, the app provides him with the opportunity of another try.

With regard to grammar, it is implicitly practiced with the *Mondly VR* app. For instance, in the vocabulary section, once the learner pronounces a word correctly, the app delivers a sentence that presents the word in context. Grammar is also implicitly practiced in the *conversation section*. The learner is provided with common phrases that are normally used in conversations (e.g. "Nice to meet you, what would you like?", "I'd like to buy...", etc.).

In terms of language competences, the learner can practice with the app three competences: listening, speaking and reading (*Table 4*).

Language contents		Vocabulary	Grammar	
		✓	✓	
Language competences	Listening	Speaking	Reading	Writing
	✓	✓	✓	✗

Table 4. Language contents and competences that are practiced with the *Mondly VR: Learn Languages in VR* app.

To this end, the *Mondly VR* app provides its learner with different contexts and opportunities for practicing meaningful conversation. Those contexts are amongst others, a hotel, restaurant, shop or taxi, where the learner can practice how to make a reservation of a room, order a menu, buy clothing or ask a taxi driver to drive the learner somewhere. It is outstanding that the interaction mode of the app is in all cases based on guided conversations. This is, the learner is asked to answer several questions by choosing from three different options. All options are provided by means of short sentences that appear on the learner's screen. Finally, reading is practiced since all vocabulary items, questions and answers from both the vocabulary and conversation section are displayed on the learner's screen (*Figure 23*).

Figure 23. Screenshot from the *Mondly VR: Learn Languages* app illustrating an example for making a reservation of a room.

The language approach provided by the *Mondly VR* app is based on an individual learning approach. The app provides the learner with real-world like scenarios where s/he can practice meaningful conversations. What makes *Mondly VR* a valuable tool for foreign language learning is its learning approach and variety of learning scenarios that allow the learner to practice a great variety of vocabulary items and useful expressions to be applied in real-world conversation.

Regarding the fifth most downloaded app, which is *VR Learn English,* the app allows the learner to explore a house with its different rooms and objects by walking around and pointing at the different objects with his/her VR headset. Once the learner has pointed at a concrete object, the app provides its respective name by displaying it on the learner's screen and delivering an audiofile. Both aim to help the learner familiarizing with the correct pronunciation of each word (*Figure 24*).

Figure 24. Screenshot from the *VR Learn English* app.

In terms of language contents, the app focuses on learning vocabulary, by providing vocabulary related to a house and its different rooms (e.g. kitchen, bedroom, living and dining room, etc.) as well as the objects that can be found in these rooms (e.g. cooktops, wardrobe, television, etc.). In terms of grammar, the *VR Learn English* app does not provide any kind of exercise. Instead, the app focuses once again primarily on vocabulary.

The different language competences that can be practiced with the *VR Learn English* app are listening and reading (*Table 5*). Reading is practiced by displaying the different vocabulary items on the screen when the learner points at an object with his/her VR headset. Listening is practiced together with reading, by providing the correct pronunciation of the word once its respective name has been displayed on the screen.

Language contents		Vocabulary	Grammar	
		✓	✗	
Language competences	Listening	Speaking	Reading	Writing
	✓	✗	✓	✗

Table 5. Language contents and competences that are practiced with the *VR Learn English* app.

Although the app does not focus on aspects such as grammar, that are generally related to form-focused learning, the app invites the learner to pay attention to linguistic forms in order to familiarize him/her with the correct pronunciation of each word. Consequently, the *VR Learn English* app is based on an individual and form-focused learning approach.

Finally, the sixth most downloaded app is *Virtual Reality Speaking Simulator*. The app allows its learners to choose between three different levels of difficulty: easy, medium and high. Once the learner has chosen the difficulty s/he wants to focus on, the app delivers a word on the screen and provides the learner with the correct pronunciation of the respective term/word (*Figure 25*).

Figure 25. Screenshot of the *Virtual Reality Speaking Simulator* app displaying the three different levels of difficult.

After that, the learner must repeat the word by pronouncing it correctly. If the learner's pronunciation is correct, the *Virtual Reality Speaking Simulator* app delivers a new word to be pronounced. On the contrary, in case the learner pronounced the word incorrectly, the app allows him/her to try again until s/he is able to pronounce the given word correctly. To help the learner practicing his/her pronunciation, the app provides, before each try, an audiofile with the correct pronunciation (*Figure 26*).

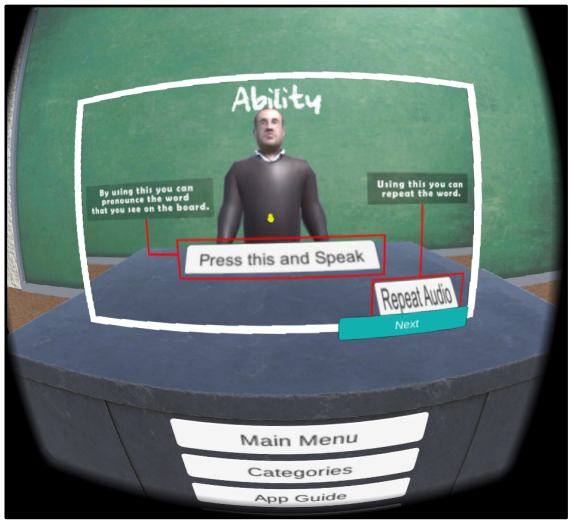

Figure 26. Screenshot from the *Virtual Reality Speaking Simulator* app.

In terms of language contents, the vocabulary provided is not organized by any kind of category where the learner could choose between different topics. Instead, the vocabulary is displayed randomly and completely decontextualized. In addition, the different words delivered

by the app do not have any relation between them. Following this premise, some examples of the vocabulary provided by the app are the following:

- **Low level of difficulty:** ability, about, again
- **Medium level of difficulty:** beverage, diamond, comfortable
- **High level of difficulty:** schizophrenia, defibrillator, quinoa

As previously seen during the analysis of the *VR Learn English* app, learning grammar is not considered in the app, since it primarily focuses on practicing competences such as listening, speaking and reading (*Table 6*).

Language contents		Vocabulary	Grammar	
		✓	✗	
Language competences	Listening	Speaking	Reading	Writing
	✓	✓	✓	✗

Table 6. Language contents and competences that are practiced with the *Virtual Reality Speaking Simulator* app.

Listening and speaking are practiced together by first providing the learner with the correct pronunciation of a word and then asking him/her to repeat the word correctly. Additionally, reading is practiced by displaying on the learner's screen each of the words s/he must repeat.

Despite the fact that the app does not focus on aspects such as grammar, which are generally related to form-focused learning, it can be said that the *Virtual Reality Speaking Simulator* app provides an individual and form-focused learning approach. This is evidenced firstly, by the fact that interaction takes place solely between the learner and the app, and secondly, that the app invites the learner to pay attention to linguistic forms by focusing on aspects such as the pronunciation of a word.

7. RESULTS

Once the analysis of all 6 apps has been conducted, the results show that, in terms of language contents, 4 of the 6 analyzed apps provide the learner with exercises for learning vocabulary. These apps are *PanoLingo*, *Mondly VR*, *VR Learn English* and *Virtual Reality Speaking Simulator*. It is remarkable that only 2 (*PanoLingo* and *Mondly VR*) of the 6 apps provide the learner with exercises for practicing grammar. Finally, there are 2 apps (*VirtualSpeech-VR Courses* and *Beyond VR*) that do not provide the learner with any exercise for learning neither for vocabulary nor grammar, since they were not specifically designed for learning English (*Figure 27*).

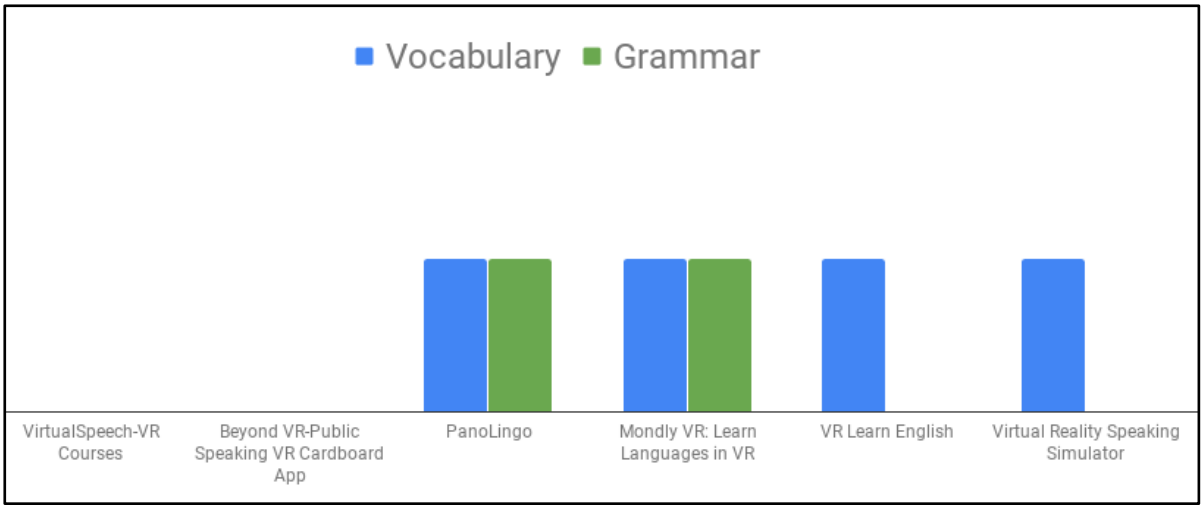

Figure 27. Language contents that are practiced with the analyzed apps.

Concerning the results of the language competences that are practiced with the 6 analyzed apps, all 6 apps work on listening and reading, 4 apps work on speaking (*VirtualSpeech-VR Courses*, *Beyond VR*, *Mondly VR* and *Virtual Reality Speaking Simulator*), while any app works on writing (*Figure 28*). Comparing language contents and language competences, while 4 of the analyzed apps (*PanoLingo*, *Mondly VR*, *VR Learn English* and *Virtual Reality Speaking Simulator*) are designed to teach vocabulary, all of the analyzed apps focus on the practice of listening and/or speaking. In terms of strengthening listening skills, all 6 apps were designed to achieve that goal. However, not all of the analyzed apps work on speaking. Apps which do not focus on speaking skills are, for instance, *VR Learn English* and *PanoLingo*.

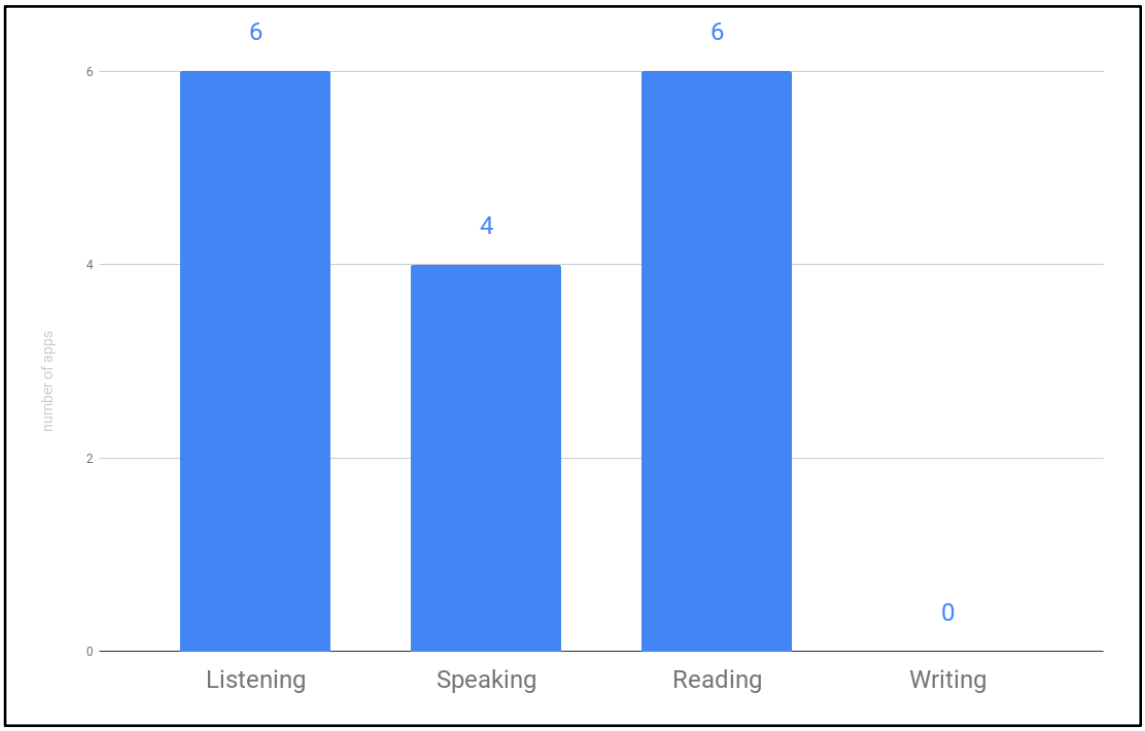

Figure 28. Language competences that are practiced with the analyzed apps.

Regarding the learning approach, the results show that all the analyzed apps are based on an individual learning approach. At the same time, 1 of the apps (*PanoLingo*) is based on a task-based learning approach. And finally, 2 apps are based on a form-focused learning approach (*VR Learn English* and *Virtual Reality Speaking Simulator*).

8. CONCLUSIONS AND FUTURE WORK

This study analyzed the 6 most popular apps from *Google Play Store* and *App Store* related to VR and language learning, with a special focus on learning English as a foreign language. The purpose of the study was to analyze the educational potential of VR technology combined with the use of smartphones and to find evidences in favor or against the 3 hypotheses established at the beginning of our study (H_1: *VR provides new opportunities for learning vocabulary and strengthening oral skills*; H_2: *The use of VR technology allows to create highly immersive environments that are often difficult or, even, impossible to implement in conventional learning environments*; and H_3: *The majority of commercial apps based on VR, provide individual and form-focused learning approaches rather than collaborative and communicative-based approaches*).

Throughout the analysis, we have been able to see how VR-based apps provide valuable opportunities for supporting students in their vocabulary learning and strengthening oral skills, hence confirming the validity of the first hypothesis (H_1). With regard to the second hypothesis (H_2), results suggest that very few of the currently available commercial apps explore the potential of VR for creating those kind of immersive learning environments that are generally difficult to implement in conventional learning environments, but which could provide learners with very valuable learning tools to support their language learning process. However, commercial apps which have made an effort in this direction are *VirtualSpeech-VR Courses*, *Beyond VR* and *VR Learn English.* While the first and the second one recreates the environment of an auditorium where the learner can practice how to give a speech in front of a virtual audience, the third one recreates a house where the learner can move and interact with different objects, acquiring important vocabulary and practicing aspects such as pronunciation.

Concerning the third hypothesis (H_3), the results from the analysis indicate that regardless the fact that some of the analyzed apps provide less conventional learning environments, by recreating immersive environments, none of the analyzed apps provide a novel learning approach, neither in terms of vocabulary learning nor in terms of practicing oral skills. Instead, all 6 apps offer a conventional, individual and form-focused learning approach, focusing mainly on drill-based and traditional reading exercises to enhance vocabulary learning as well as oral skills (speaking and listening). Taking into consideration the aforementioned aspects together with the fact that the added value of VR technologies lies in the potential of providing novel possibilities for creating immersive and interactive learning environments based on collaborative, constructive or experiential learning approaches, it becomes clear that VRALL designers still face important challenges in order to explore the real potential of VR technologies.

For future work, we intend to address some of the mentioned challenges by designing in collaboration with the Department of Computer Engineering (University of Cádiz) a VR-based app for foreign language learning applying all the insights gained during the analysis of the 6 apps.

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11. APPENDIX

		Vocabulary	Grammar		
Language contents	*Virtual Speech-VR Courses*	✗	✗		
	Beyond VR-Public Speaking	✗	✗		
	PanoLingo	✓	✓		
	Mondly VR: Learn Languages in VR	✓	✓		
	VR Learn English	✓	✗		
	Virtual Reality Speaking Simulator	✓	✗		
		Listening	Speaking	Reading	Writing
Language competences	*Virtual Speech-VR Courses*	✓	✓	✓	✗
	Beyond VR-Public Speaking	✓	✓	✓	✗
	PanoLingo	✓	✗	✓	✗
	Mondly VR: Learn Languages in VR	✓	✓	✓	✗
	VR Learn English	✓	✗	✓	✗
	Virtual Reality Speaking Simulator	✓	✓	✓	✗

Table 7. Language contents and competences that are practiced with the analyzed apps.